

# **MARKING ON BONES MUSCLE NOMENCLATURE AND LEVER SYSTEMS**

Anatomy & Physiology I

# OBJECTIVES

- **Bone Markings** - Chp. 7 - Tortora
- **Axial Skeleton** - Skull, Vertebral Column & Thorax - Chp. 7 Tortora; **Moore**- parts of Chps. 1, 4, 7 & 8
- **Joints** - Chp. 9 - Tortora
- **Muscular System** - Chp. 11 - Tortora; **Moore**- parts of Chps. 1, 4, 7 & 8

# **BONE MARKINGS**

**See Table 7-2, p. 187 -  
Tortora**



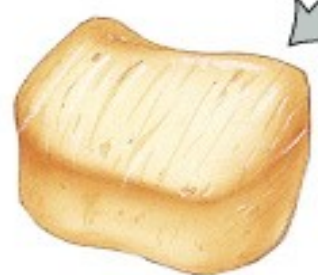
Long bone  
(humerus)



Flat bone  
(sternum)



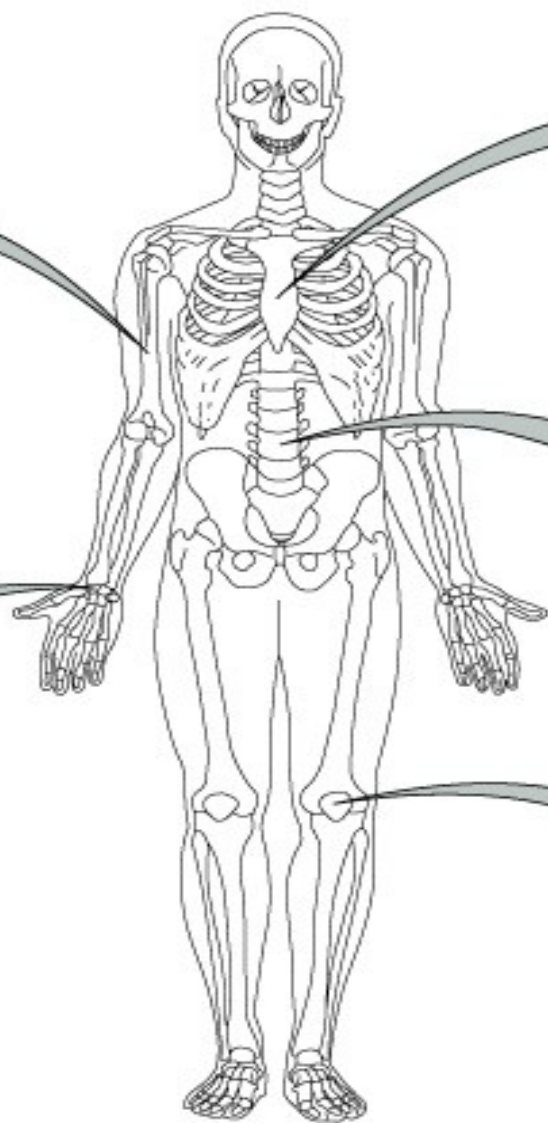
Irregular bone  
(vertebra)



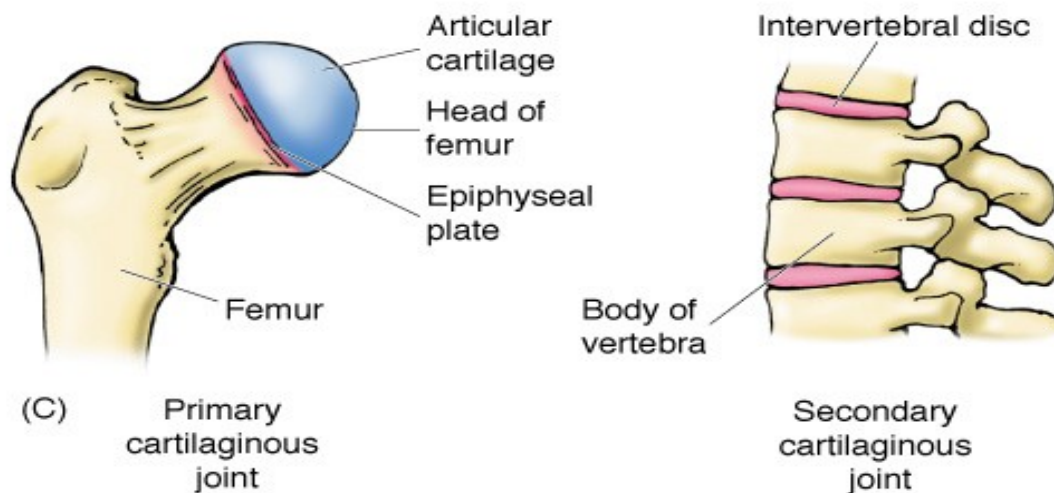
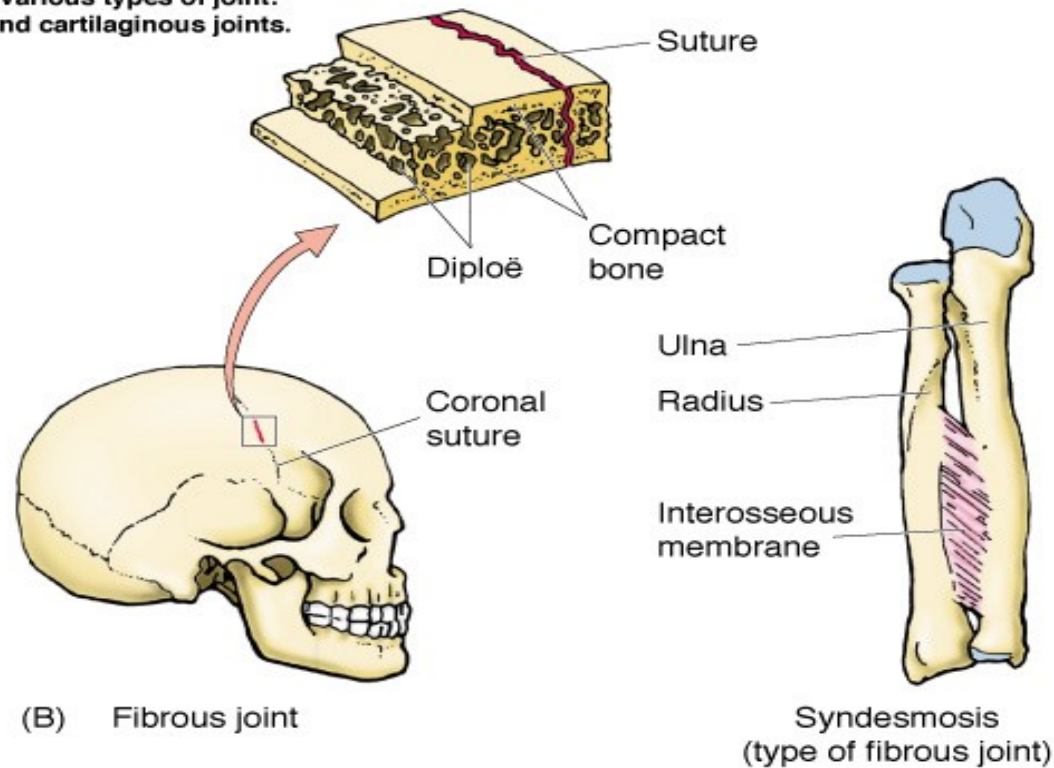
Short bone  
(trapezoid, wrist bone)

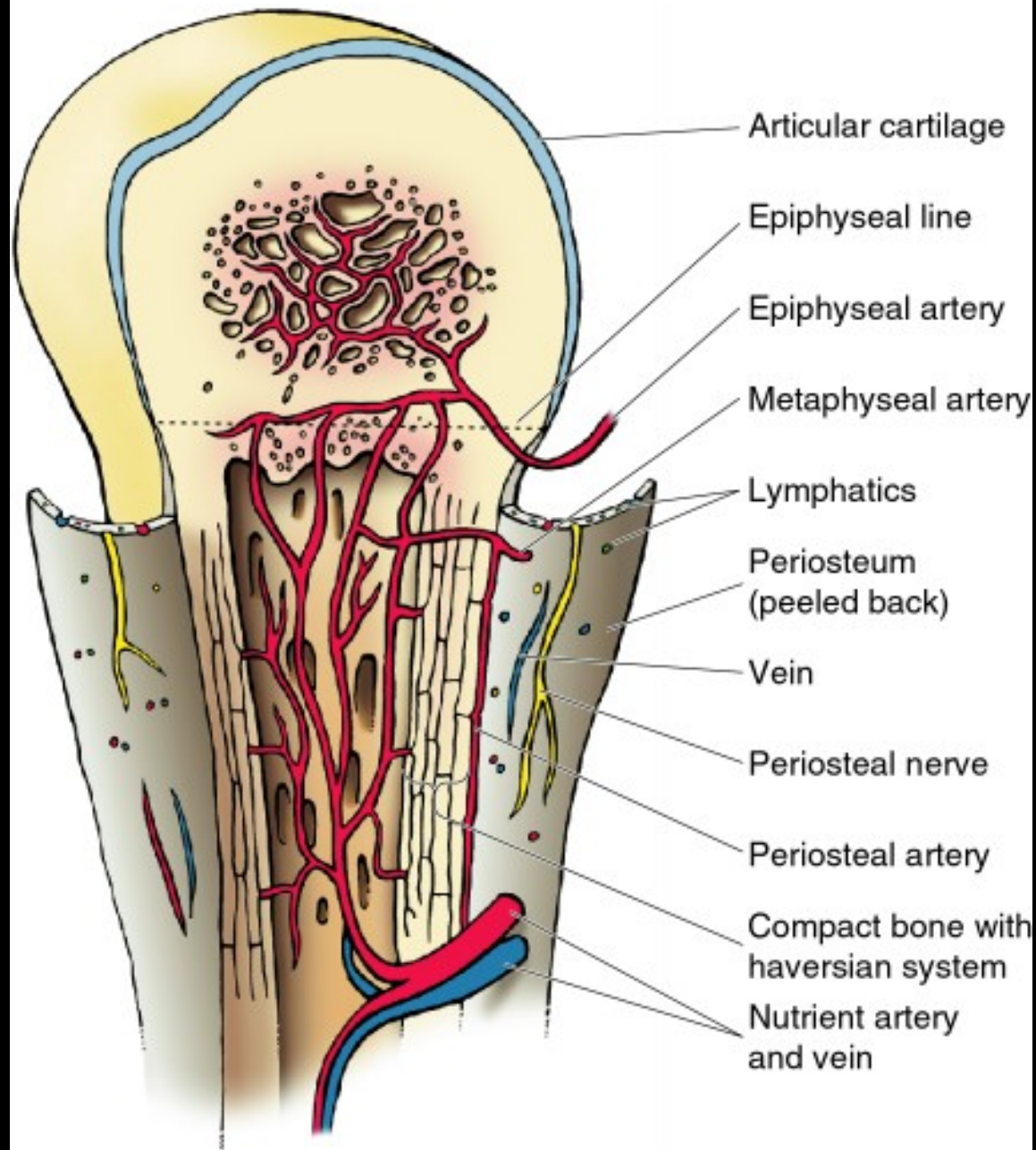


Sesamoid bone  
(patella)

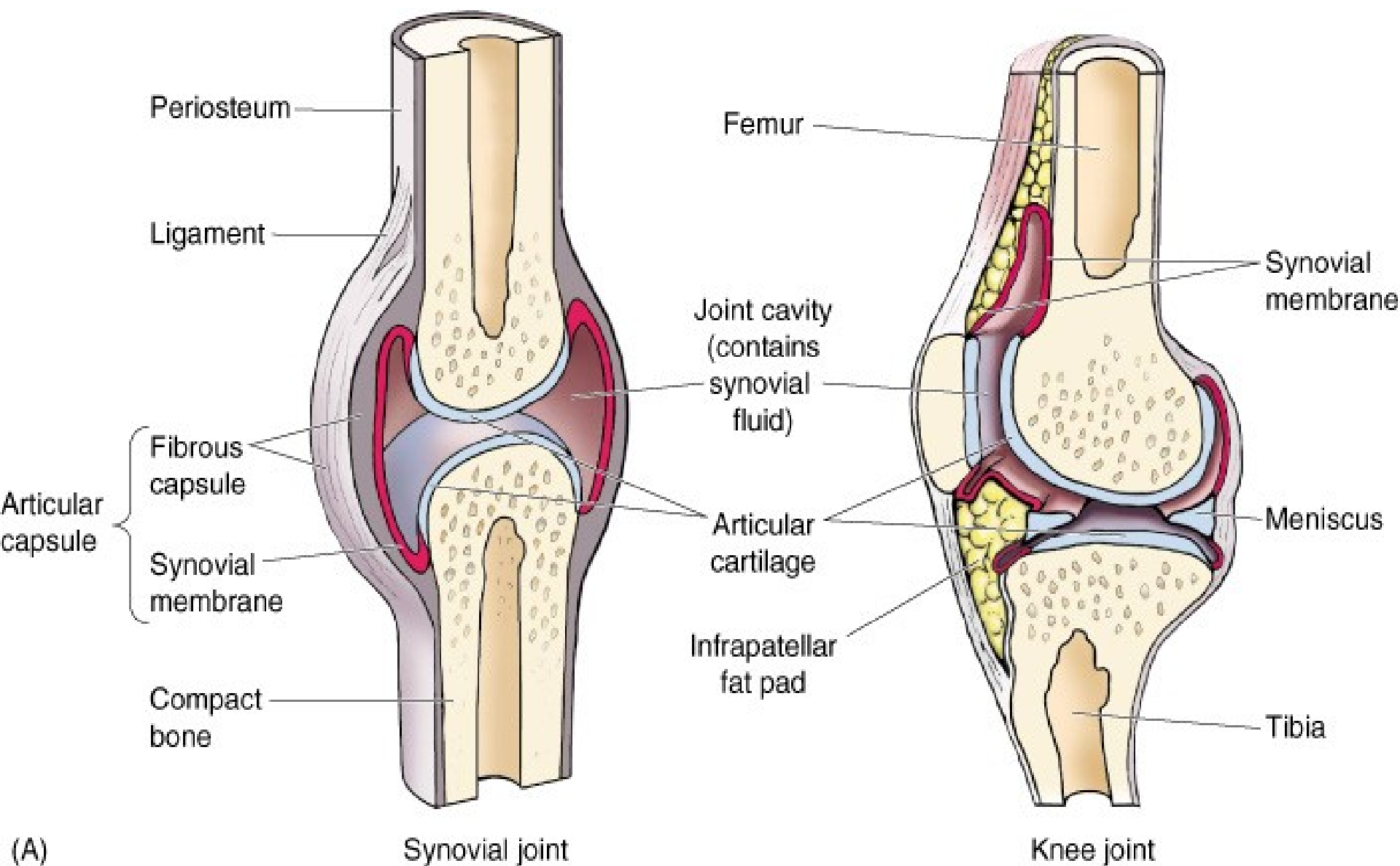


I.13B, C. Various types of joint:  
fibrous and cartilaginous joints.





I.13A. Various types of joint: synovial joint.





# Surface Markings

- Surface markings include all structural features visible on the surfaces of bones.
- Bones have a variety of bumps (prominences), depressions, and openings (foramina).



# Surface Markings

- Surface markings appear where tendons, ligaments, and fascia (fibrous membranes) are attached to the bone; where **blood vessels** and **nerves** enter and exit the bone; and at the **joints** between bones.

# Depressions & Openings

- **Canal** or **Meatus**: a narrow tube, channel, or passageway.
  - *Example*: external auditory canal (also called external auditory meatus).
- **Foramen** (foramen = hole): opening through which blood vessels, nerves, or ligaments pass.
  - *Example*: mental foramen of the mandible.

# Depressions & Openings

- **Fossa** (Fossa = basin-like depression): a hollow or depression in a bone.
  - *Example*: radial and coronoid fossae of the humerus.
- **Groove** or **Sulcus** (sulcus = ditch-like groove): a furrow or depression in a bone.
  - *Example*: intertubercular sulcus of the humerus.

# Depressions & Openings

- **Notch**: an indentation at the edge of a bone.
  - *Example*: intercondylar notch of the femur.

# Processes that Form Joints

- **Condyle** (condyle = knuckle): a large, rounded articular prominence.
  - *Example*: lateral and medial condyles of the femur and tibia.
- **Facet** (facet = little face): a smooth, flat surface.
  - *Example*: articular facet of a vertebra.

# Processes that Form Joints

- **Head**: a rounded articular projection supported on the constricted portion of a bone.
  - *Examples*: heads of the humerus, radius, femur, and fibula.
- **Malleolus** (malleus = hammer): a hammerhead -like articular projection.
  - *Examples*: medial and lateral malleoli of the tibia and fibula.

# **Processes to which Tendons, Ligaments, and other Connective Tissues Attach**



# Processes

- **Crest**: a prominent border or ridge.
  - *Example*: intertrochanteric crest of the femur.
- **Epicondyle** (epi = upon): a prominence above a condyle.
  - *Examples*: lateral and medial epicondyles of the humerus and femur.
- **Line** or **Linea**: a ridge less prominent than a crest.
  - *Example*: linea aspera of the femur.

# Processes

- **Spinous Process** or **Spine**: a sharp, slender process.
  - *Example*: spinous process of a vertebra.
- **Trochanter**: a large projection found only on the femur.
  - *Examples*: greater and lesser trochanters of the femur.

# Processes

- **Tubercle**: a small, rounded process.
  - *Examples*: greater and lesser tubercles of the humerus.
- **Tuberosity**: a large, rounded, usually roughened process.
  - *Examples*: deltoid, radial, and gluteal tuberosities of the humerus, radius, and femur.

# **MUSCLE NOMENCLATUR E**

# **FUNCTIONS OF MUSCLE**

- **Locomotion**
- **Mechanical digestion**
- **Propulsion**
- **Sphincters**
- **Ventilation**
- **Communication**

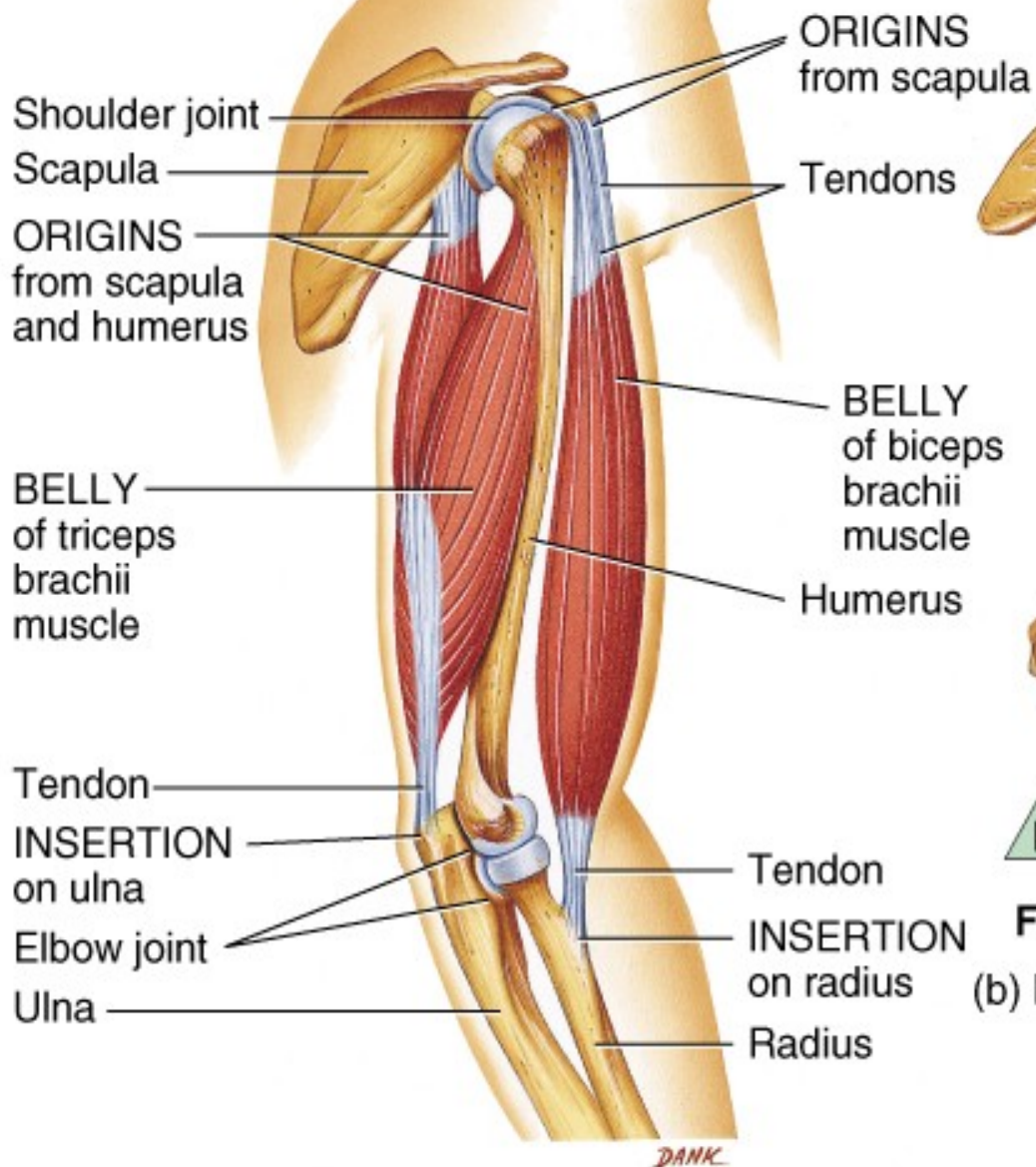
# Naming Skeletal Muscles

- There are about 700 skeletal muscles.
- They are named on the basis of distinctive criteria: size, shape, location, action, origin and insertion, number of origins (or heads), and direction of muscle fibers.

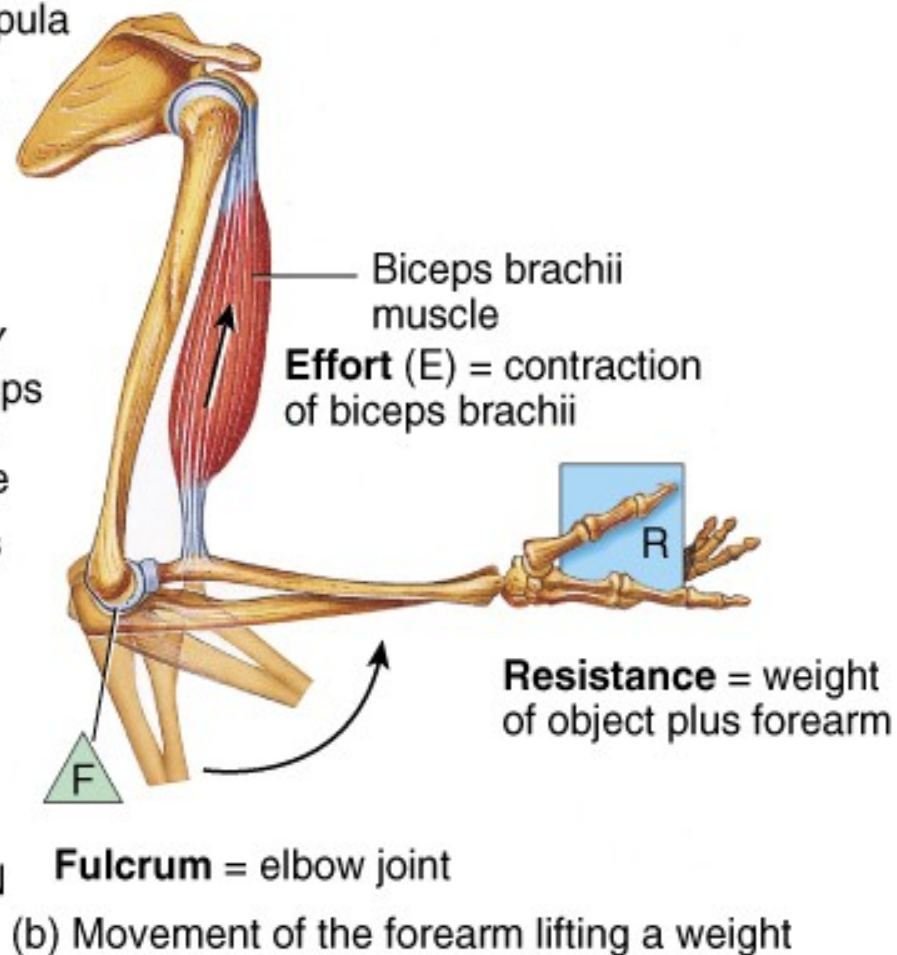
# Naming Skeletal Muscles

- **Origin:** the end of a muscle that attaches to a bone that remains stationary during muscle contraction.
- **Insertion:** the end of a muscle that attaches to a bone that moves during muscle contraction.





(a) Origin and insertion of a skeletal muscle



# Origin and Insertion

- *Example:* **sternocleidomastoid**
  - (*origin:* sternum and clavicle;
  - *insertion:* mastoid process).
- *Example:* **sternohyoid**
  - (*origin:* sternum;
  - *insertion:* hyoid bone).

# Number of Origins

- **Biceps:** **two** origins.
  - *Examples* biceps brachii; biceps femoris.
- **Triceps:** **three** origins.
  - *Example* triceps brachii.
- **Quadriceps:** **four** origins.
  - *Example* : quadriceps femoris.

# Group Actions

- Most movements require several skeletal muscles acting in groups.
- A group may include some combination of the following categories of muscles:
  - **Prime Mover (Agonist)**: the muscle that produces the desired action.
  - **Antagonist**: a muscle that produces an action opposite that of the prime mover.

# Group Actions

- ***Synergist***: a muscle that assists the prime mover by reducing unnecessary movement.
- ***Fixator***: a muscle that stabilizes the origin of the prime mover to increase efficiency.

# Size

- **Maximus** = *largest*. Example :  
gluteus maximus.
- **Minimus** = *smallest*. Example:  
gluteus minimus.
- **Longus** = *longest*. Example :  
adductor longus.
- **Brevis** = *short*. Example :  
peroneus brevis.

# Shape

- *Deltoid* = **triangular**. Example : deltoid.
- *Trapezius* = **trapezoid**. Example : trapezius
- *Serratus* = **saw-toothed**. Example : serratus anterior.
- *Rhomboideus* = **diamond-shaped**. Example : rhomboideus major.



# Location

- *Example : **temporalis*** (near the temporal bone).
- *Example : **tibialis anterior*** (near the front of the tibia).
- *Example : **orbicularis oculi*** (surrounding the eye).
- *Example : **orbicularis oris*** (surrounding the mouth).

# Action

- **Flexor**: decreases the angle at a joint.
  - *Example* : flexor carpi radialis.
- **Extensor**: increases the angle at a joint.
  - *Example* : extensor carpi ulnaris.
- **Abductor**: moves a bone away from the midline.
  - *Example* : abductor longus.

# Action

- **Adductor** : moves a bone closer to the midline.
  - *Example* : adductor longus.
- **Levator** : produces an upward movement.
  - *Example*: levator ani.
- **Depressor**: produces a downward movement.
  - *Example* : depressor labii inferioris.

# Action

- ***Supinator***: turns the palm upward or anteriorly.
  - *Example* : supinator.
- ***Pronator*** : turns the palm downward or posteriorly.
  - *Example* : pronator teres.
- ***Sphincter***: decreases the size of an opening.
  - *Example* : external anal sphincter.

# Action

- **Tensor**: makes a body part more rigid.
  - *Example* : tensor fasciae latae.
- **Rotator**: moves a bone around its longitudinal axis.
  - *Example* : obturator externus.

# Naming Skeletal Muscles

- **Direction of Muscle Fibers**

- **Rectus**: *fibers run parallel to the midline of the body. Example: rectus abdominis.*
- **Transverse**: *fibers run perpendicular to the midline. Example: transverse abdominis.*
- **Oblique**: *fibers run diagonally to the midline. Example: external oblique.*

# Fascicle Arrangement

- Relationship to muscle structure:
  - Circular - *Orbicularis oris*
  - Convergent - *Pectoralis major*
  - Parallel - *Sartorius*
  - Unipennate - *Extensor digitorum longus*
  - Multipennate - *Deltoid*
  - Fusiform - *Biceps brachii*
  - Bipennate - *Rectus femoris*



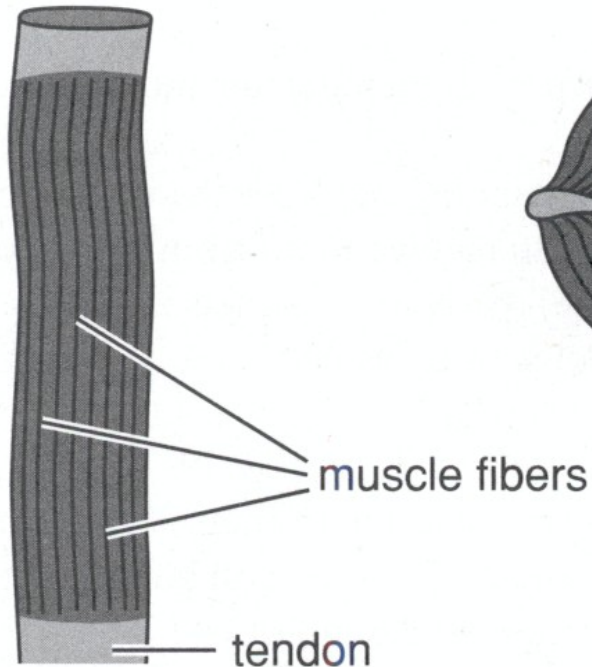
# ARRANGEMENT OF FASCICULI

**Fasciculi** : bundles of skeletal muscle fibers.

Skeletal muscle fibers are arranged in a parallel fashion within each bundle, but the arrangement of the fasciculi with respect to the tendons may take several characteristic patterns : parallel, circular, fusiform, and pennate.

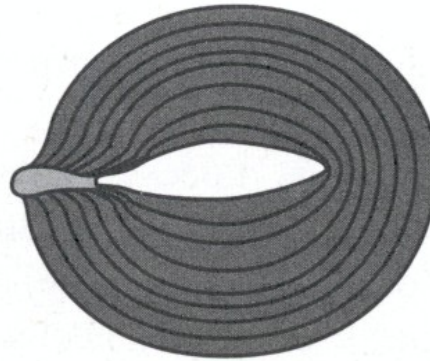
## Parallel

fasciculi are parallel with longitudinal axis of muscle and terminate at either end in flat tendons



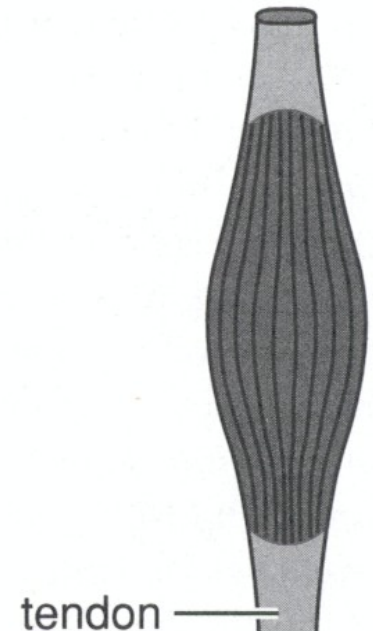
## Circular

fasciculi are arranged in a circular pattern



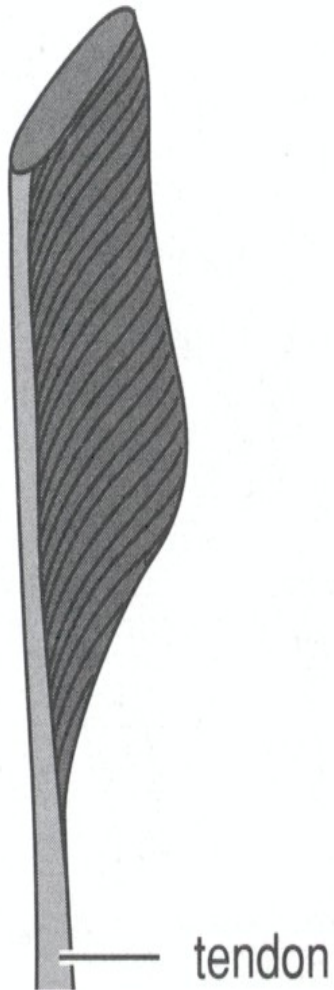
## Fusiform

fasciculi nearly parallel with longitudinal axis and muscle tapers toward tendons



## Unipennate

fasciculi are arranged  
on only one side  
of tendon



## Bipennate

fasciculi are arranged  
on both sides of  
centrally positioned tendon

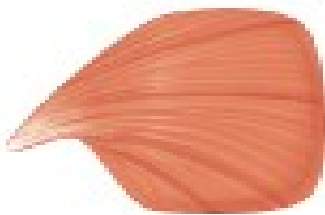


## Multipennate

fasciculi attach obliquely  
from many directions  
to several tendons

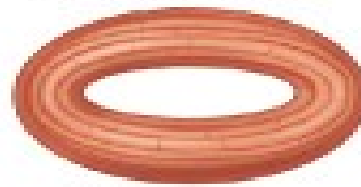


Pectoralis major



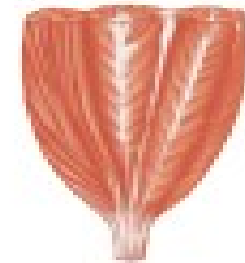
**(b) Convergent**

Orbicularis oris



**(a) Circular**

Deltoid



**(e) Multipennate**

Biceps brachii



**(f) Fusiform**

Sartorius

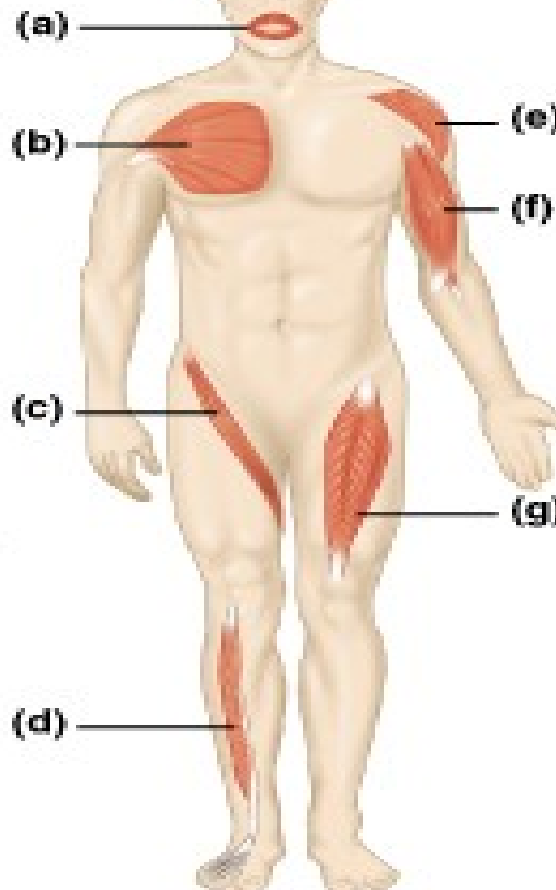


**(c) Parallel**

Extensor digitorum longus



**(d) Unipennate**



**(a)**

**(b)**

**(c)**

**(d)**

**(e)**

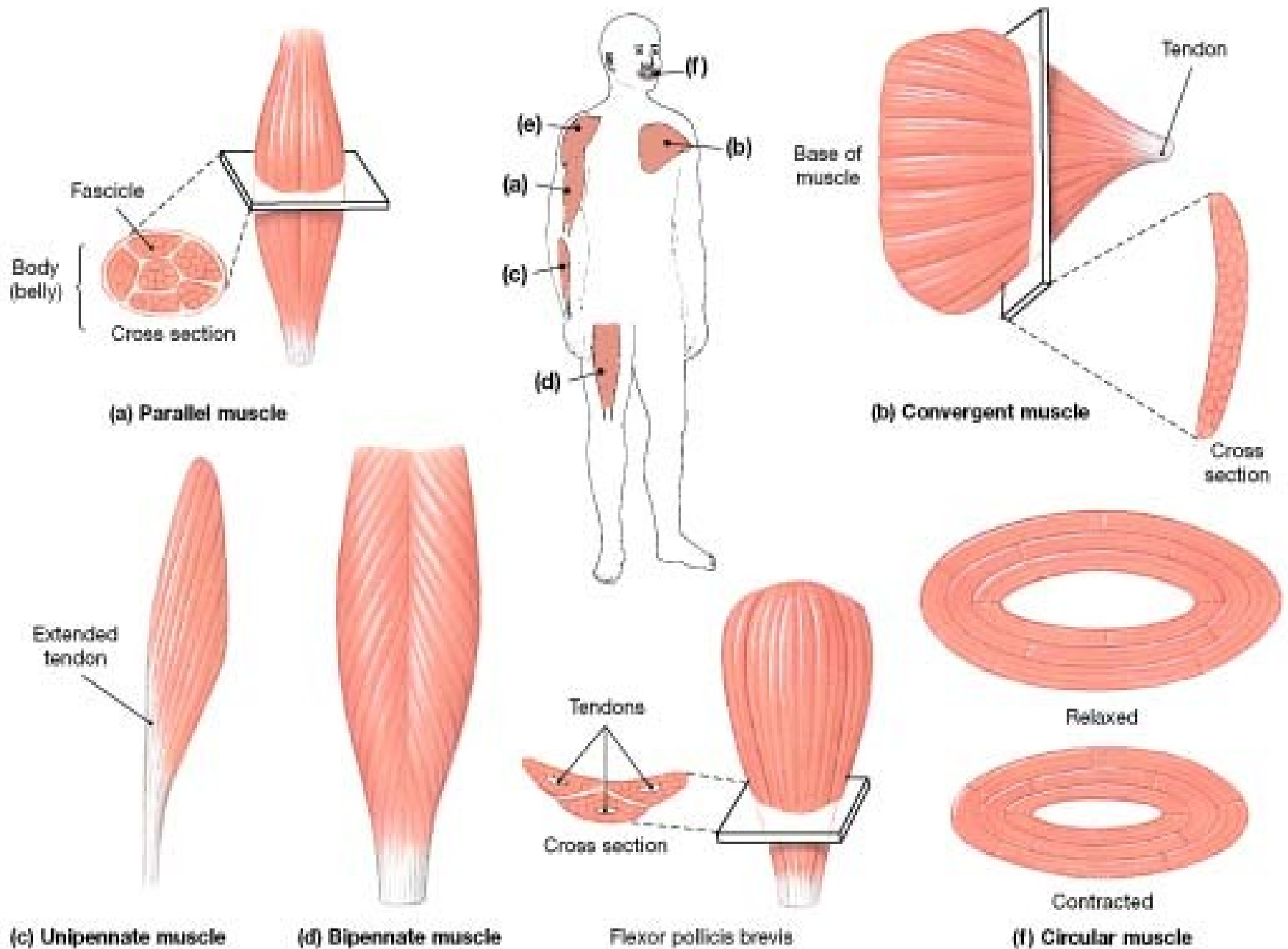
**(f)**

**(g)**

Rectus femoris



**(g) Bipennate**



• **FIGURE 11-1** Different Arrangements of Skeletal Muscle Fibers

**Circular:**

**Orbicularis oculi** —

**Orbicularis oris** —

**Convergent:**

**Pectoralis major** —

**Parallel:**

**Biceps brachii** —

**Parallel:**

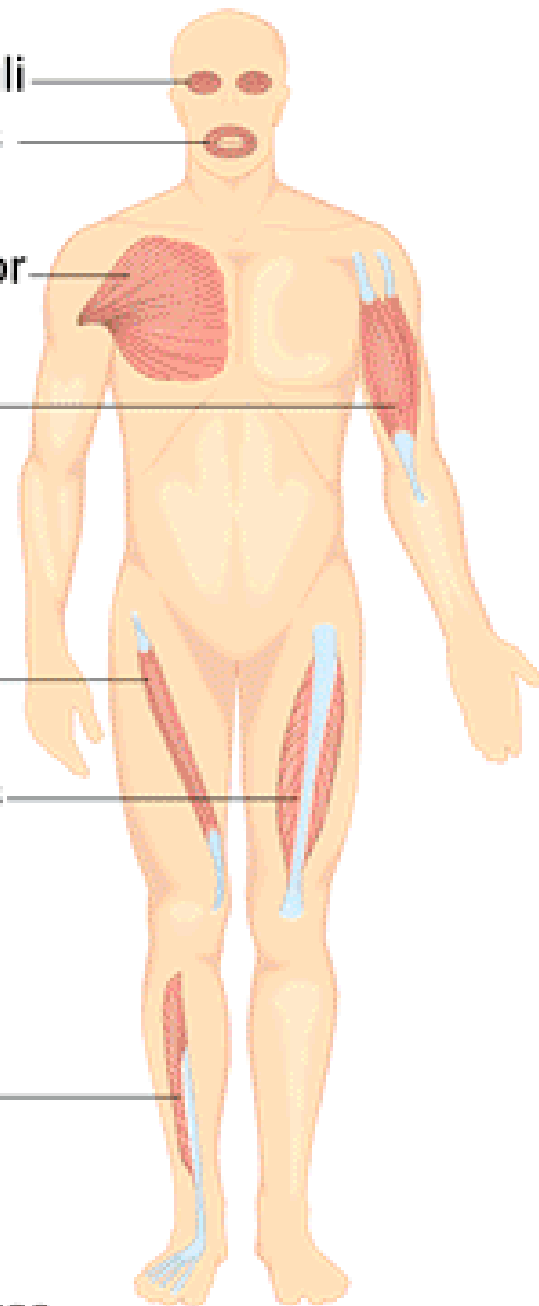
**Sartorius** —

**Bipennate:**

**Rectus femoris** —

**Unipennate:** —

**Extensor  
digitorum  
longus**



# **Muscle Mechanics**

## **Lever System**

**Bone-Muscle  
Relationship**

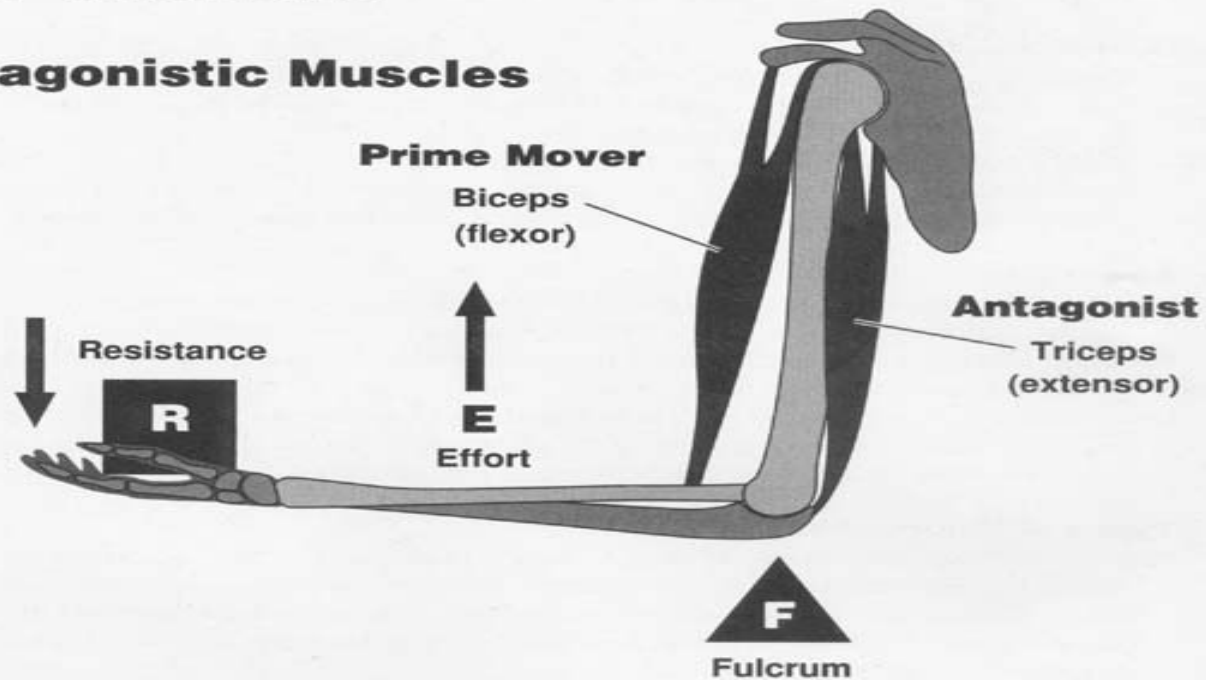
# Terminology

- **Lever**: a rigid rod used to achieve leverage.
- **Fulcrum**: the fixed point about which a lever moves.
- **Resistance**: the force that opposes movement.
- **Effort**: the force exerted to achieve an action.



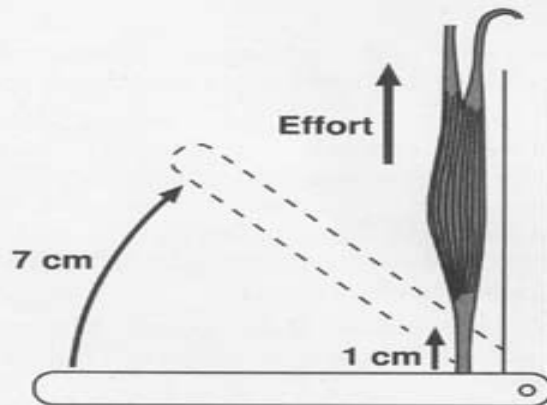
# LEVER SYSTEMS

## Antagonistic Muscles



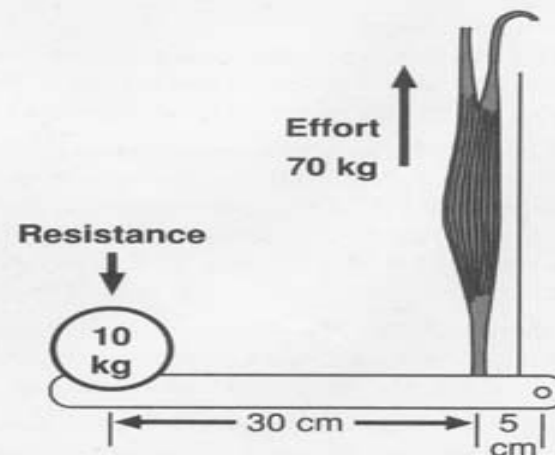
## Lever Mechanisms

### Amplification



Distance & Velocity Amplified :  
muscle shortens 1 cm  
hand moves 7 cm

### Inefficiency

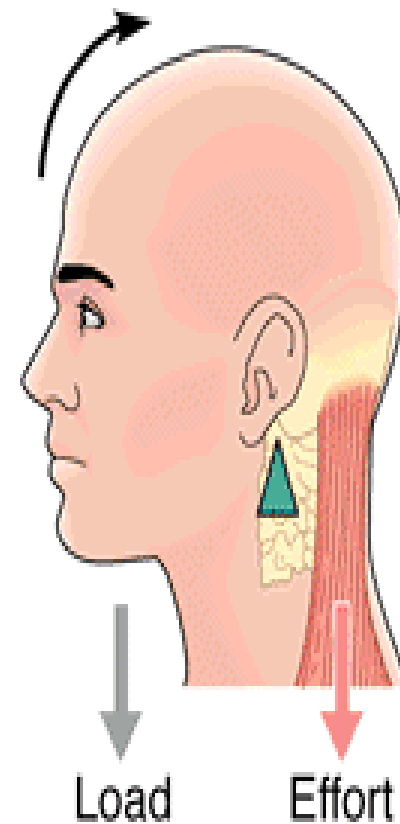
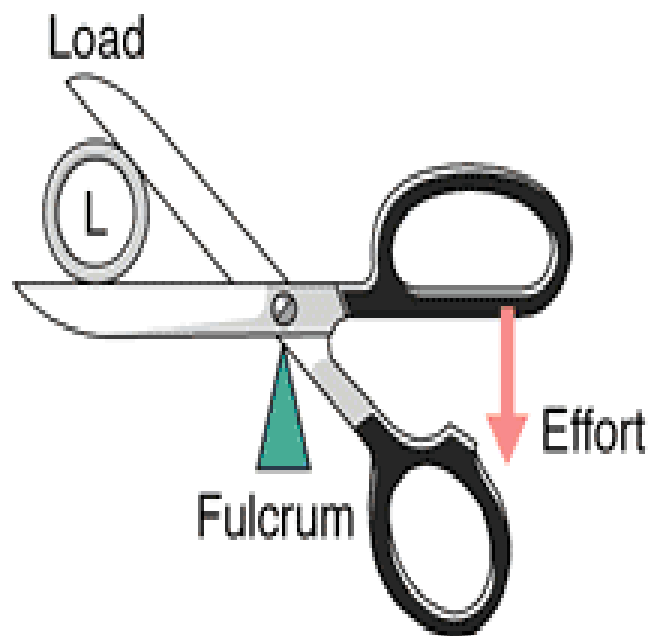
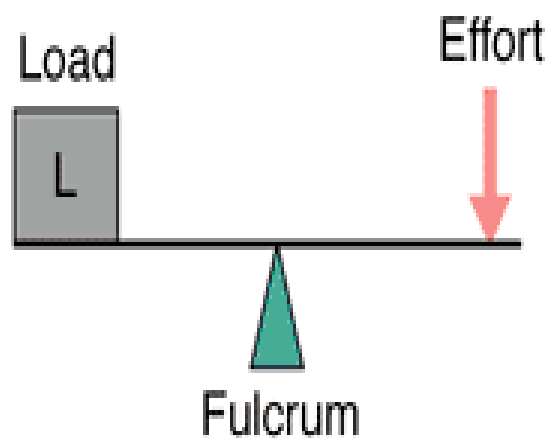


Inefficiency of Lever System :  
70 kg of muscle force required  
to hold a 10 kg weight

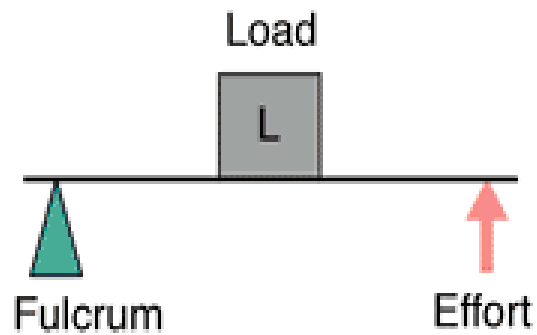


# Classification

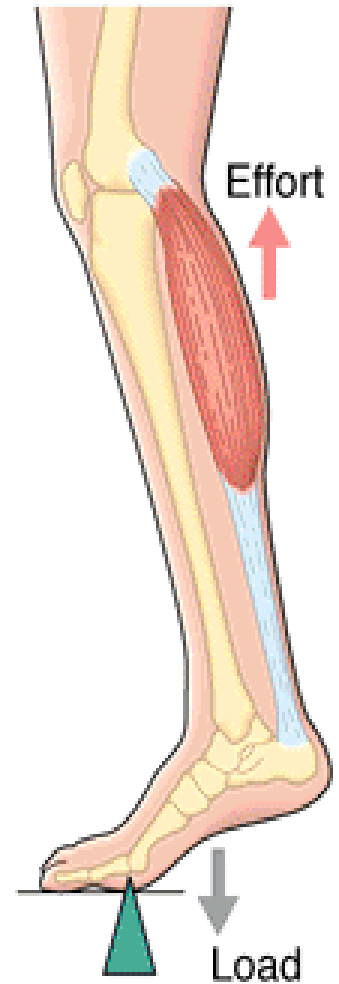
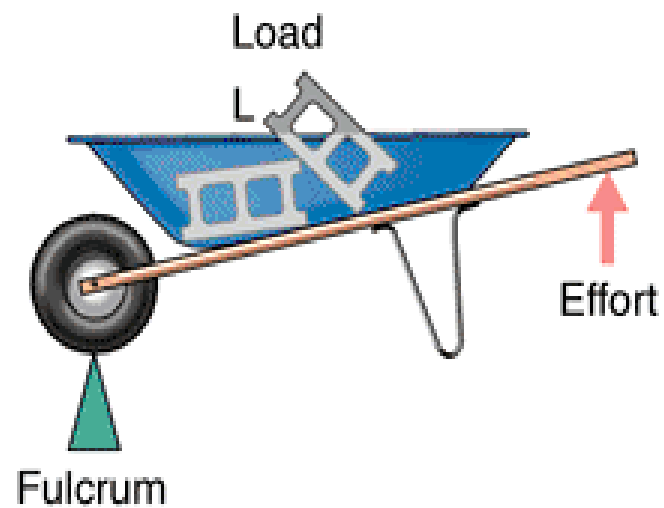
- **1st Class Levers** the fulcrum is between the effort and the resistance.
- **2nd Class Levers** the fulcrum is at one end; the effort is at the opposite end.
- **3rd Class Levers** the fulcrum is at one end; the resistance is at the opposite end.

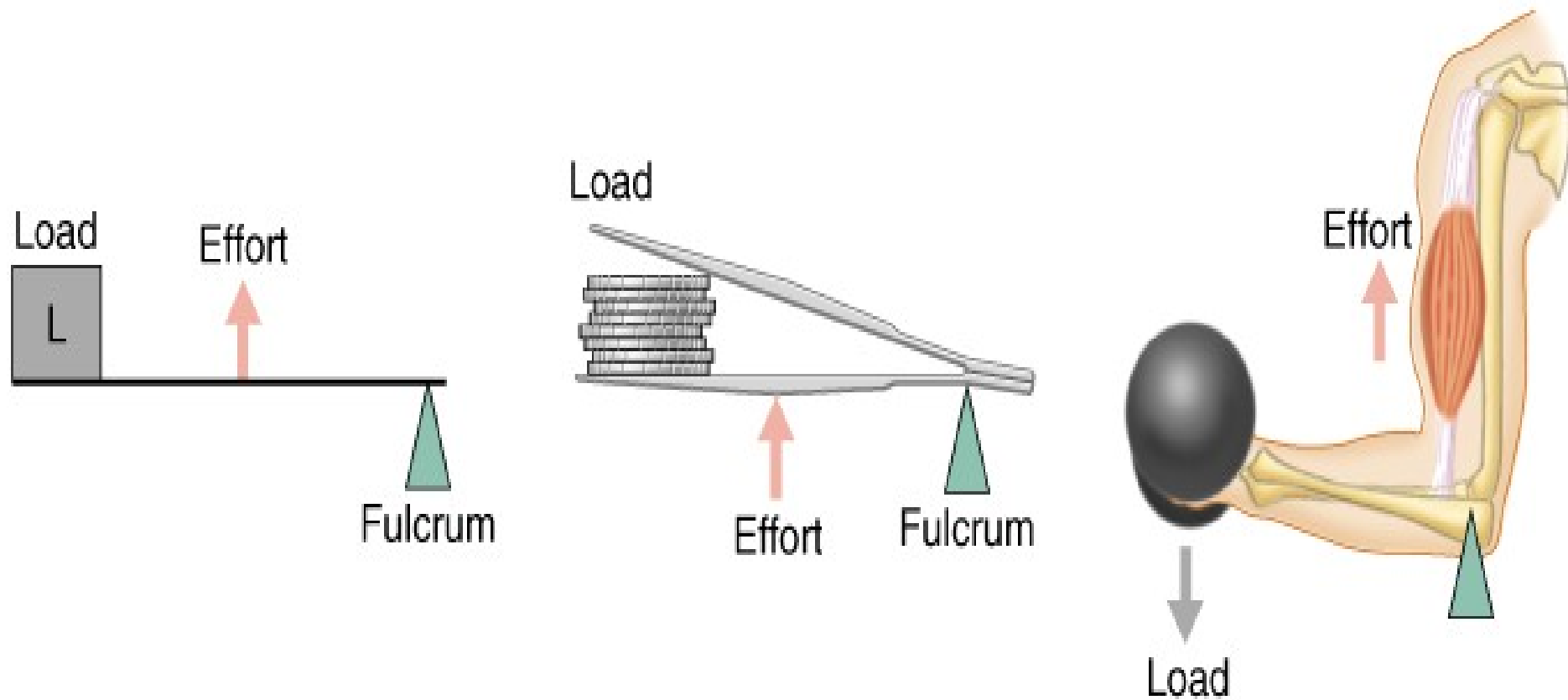


**(a) First-class lever**



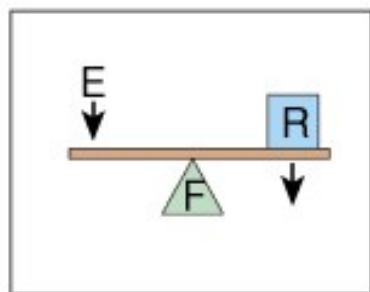
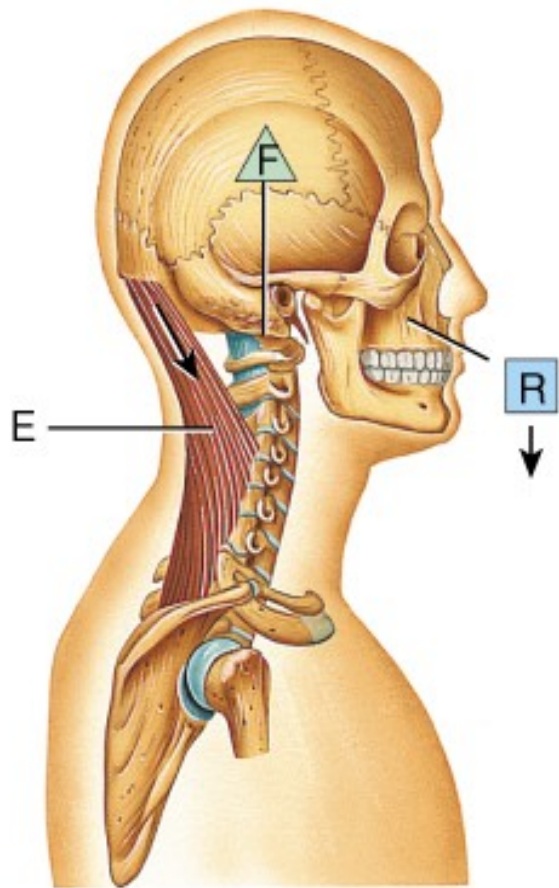
**(b) Second-class lever**



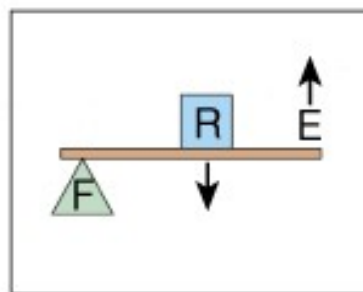
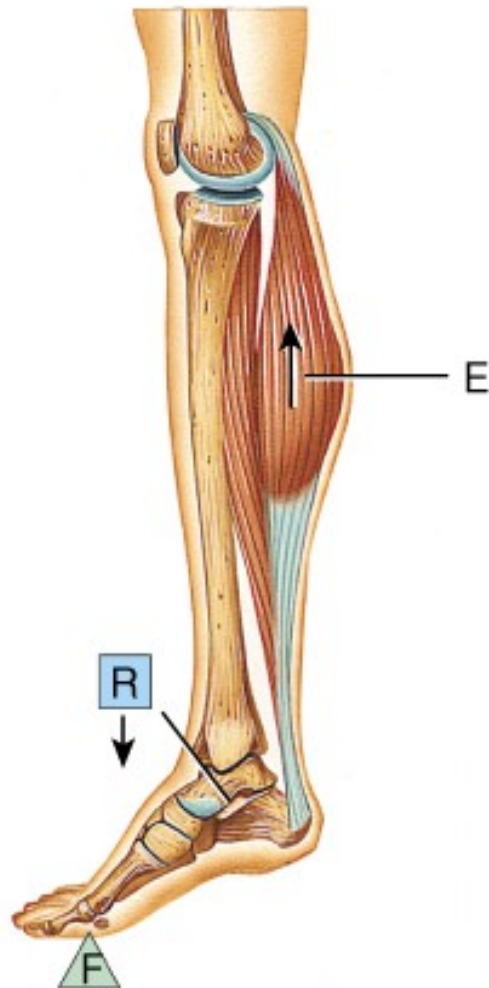


### (c) Third-class lever

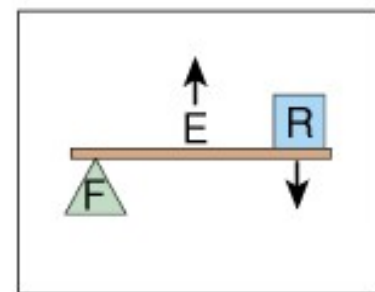
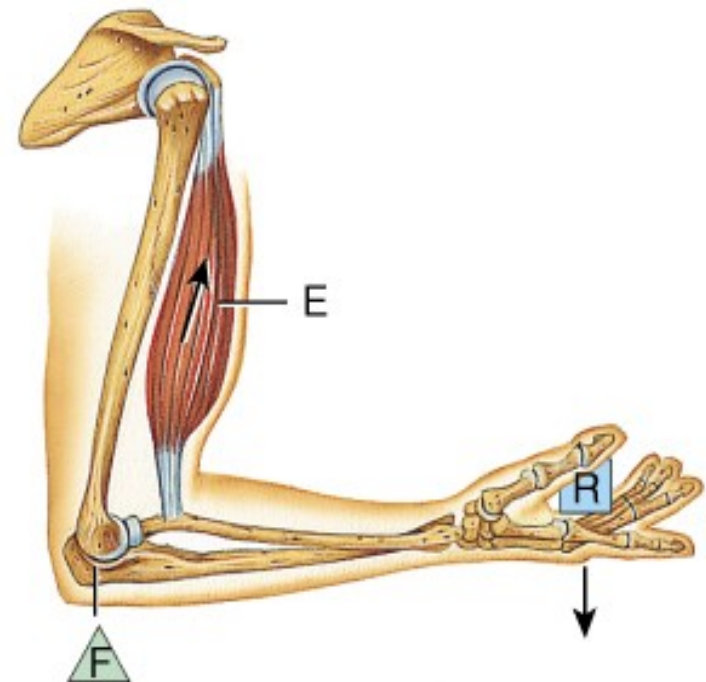
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(a) First-class lever



(b) Second-class lever



(c) Third-class lever

# Leverage

- *Leverage* is the mechanical advantage gained by a lever.
- It is largely responsible for a muscle's strength and range of motion.
- Both strength and range of motion depend on the placement of muscle attachments.
- Strength and range vary inversely.

# Strength

- **Strength** -The greater the distance between the insertion of a muscle and a joint (fulcrum), the greater the strength of the movement.

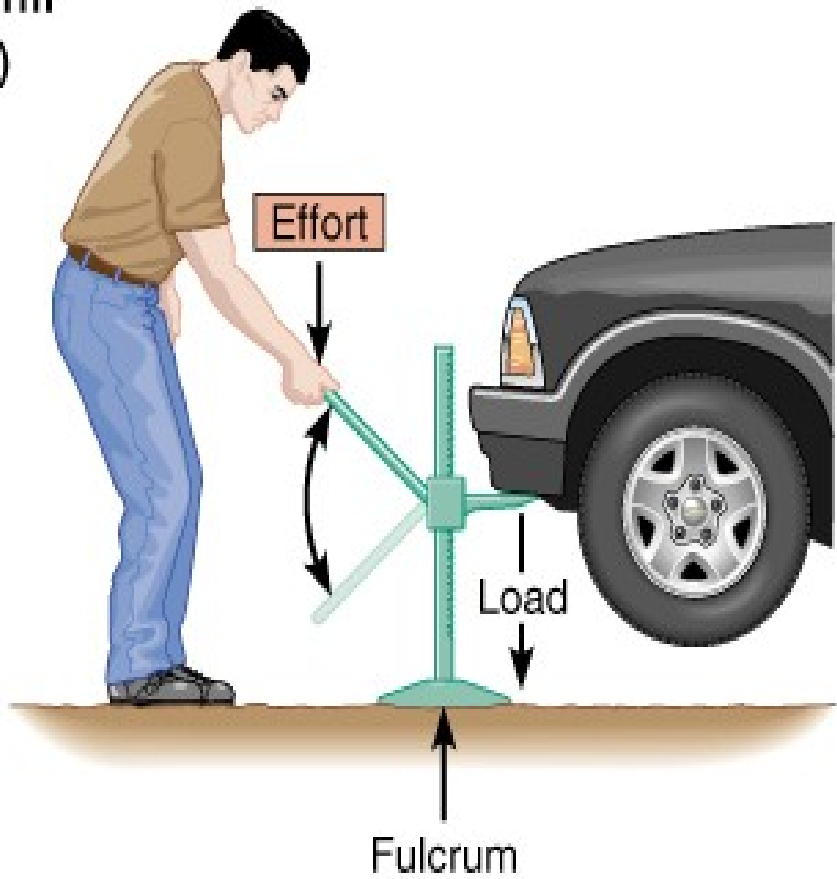
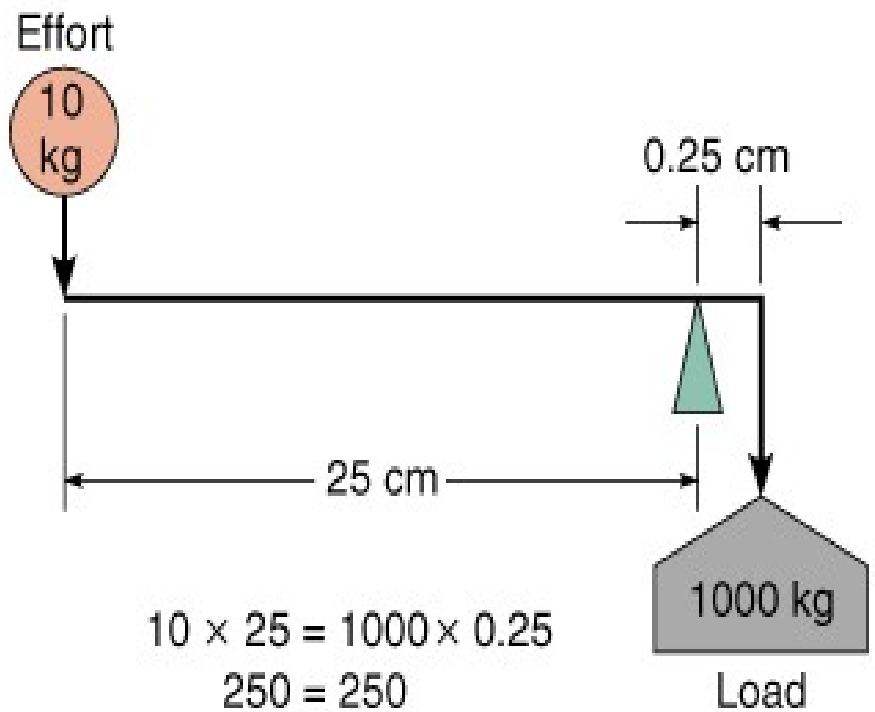
# Range of Motion (ROM)

- ***Range of Motion (ROM)*** -The shorter the distance between the insertion of a muscle and a joint, the greater the range of motion and speed of movement.

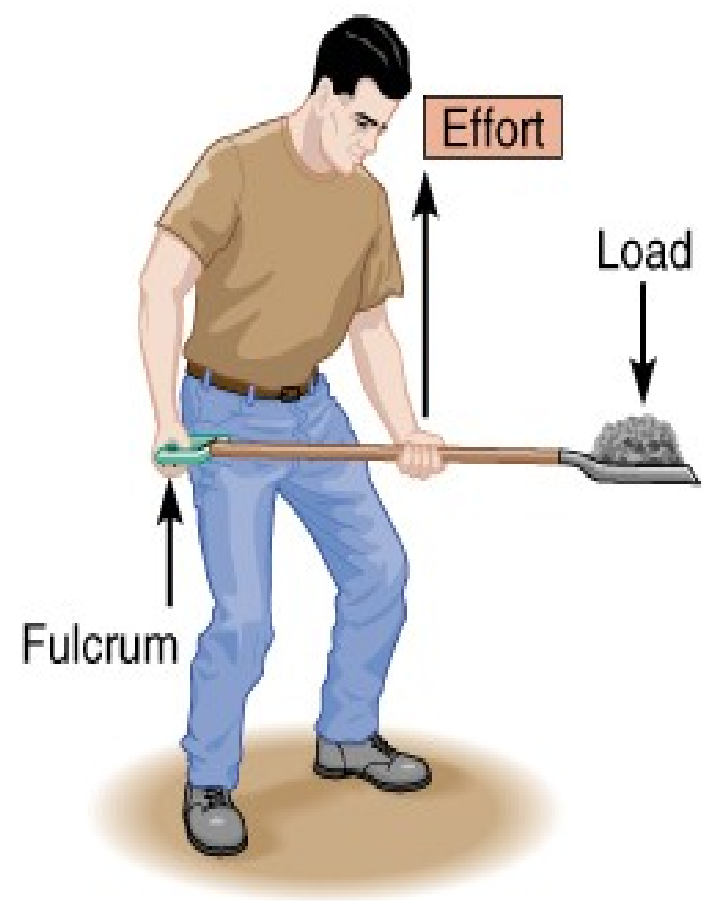
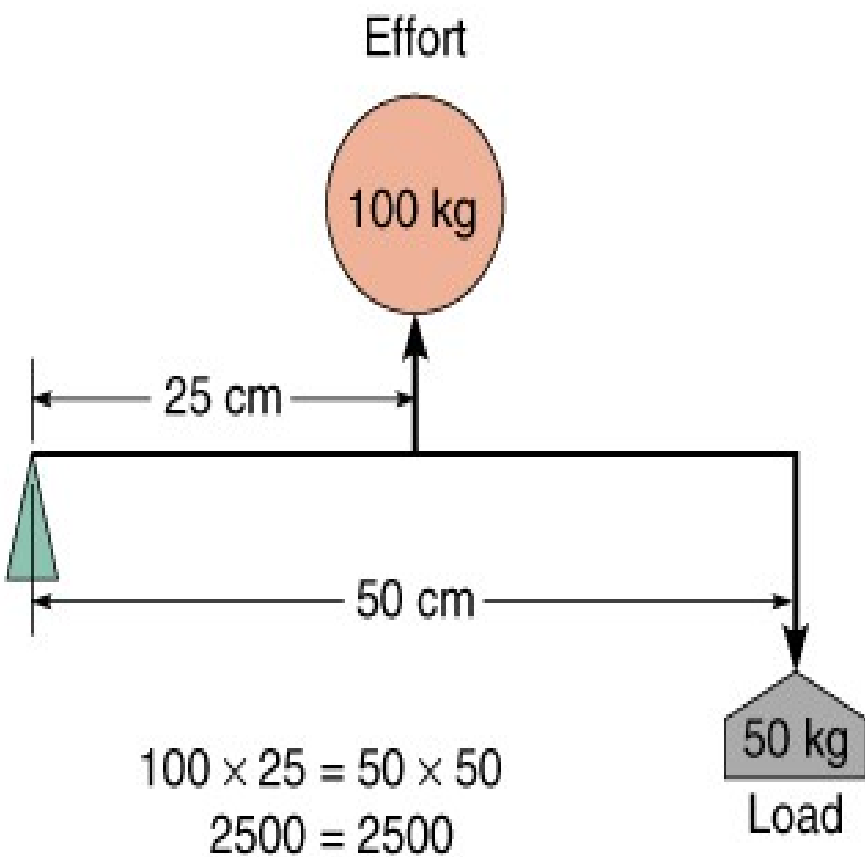


# **Example Illustrated**

**Effort × length of effort arm = load × length of load arm**  
**(force × distance) = (resistance × distance)**



**(a)**  
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**(b)**  
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